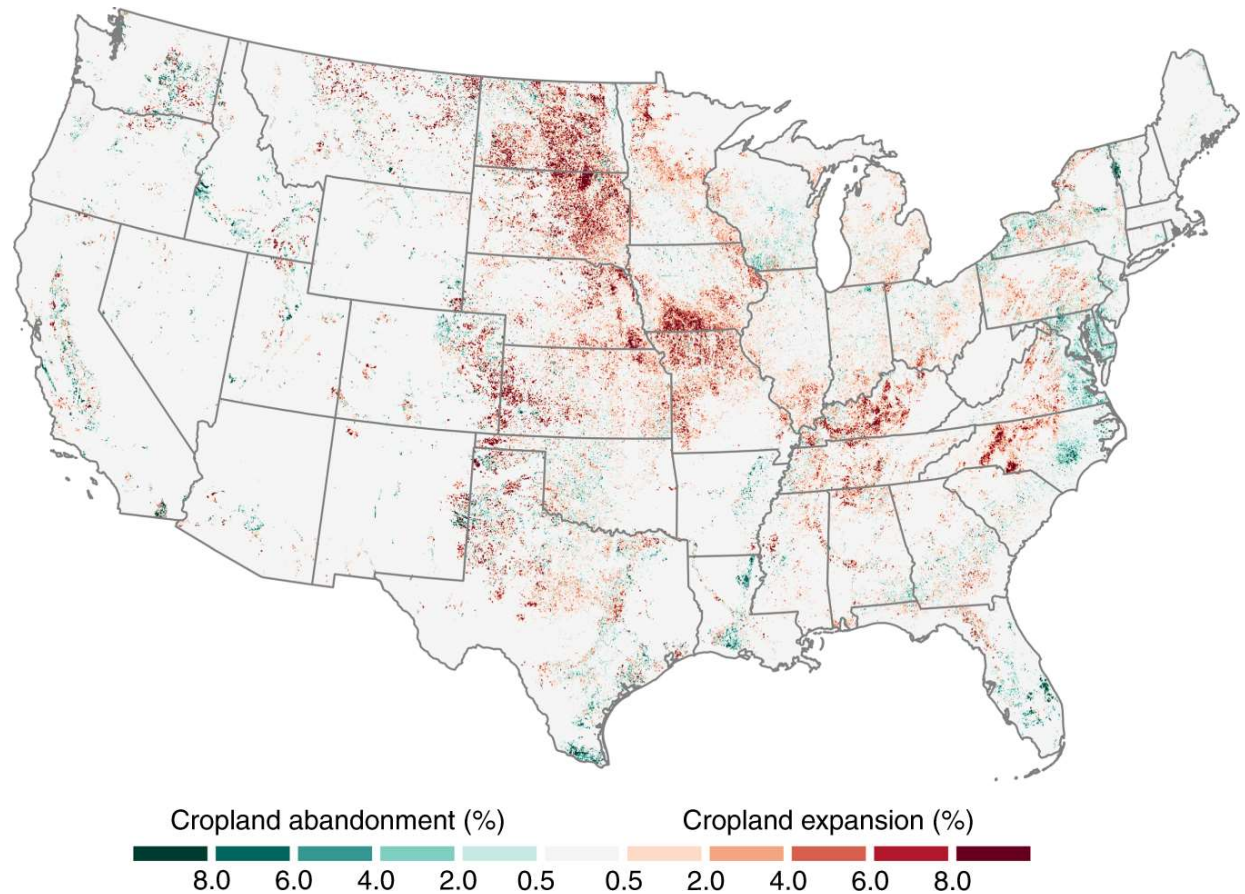


Grassland-to-cropland conversion in the US Midwest between 2008 and 2016: effects on soil quality

Stephen LeDuc, US EPA,
Office of Research and
Development

October 14, 2021



Lark et al. 2020

<https://www.nature.com/articles/s41467-020-18045-z>

The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the EPA or any other agency



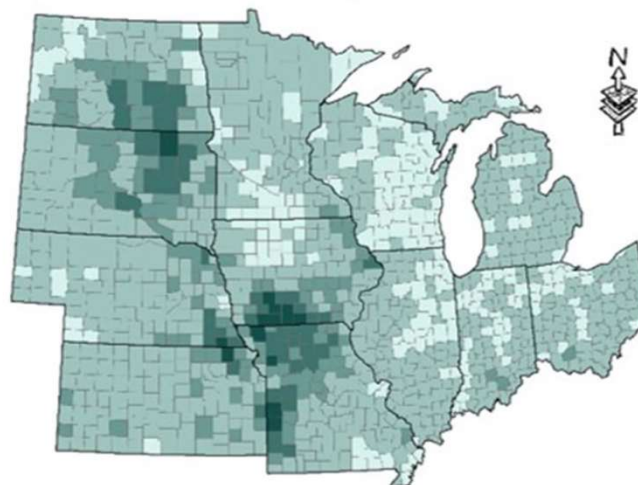
Soil Quality Modeling

- Using the estimates from Lark et al. 2020, we simulated the historic soil quality effects (2008 – 2016) of grassland conversion to cropland in the US Midwest for the 3rd Biofuels Report to Congress
- Specifically, we simulated the following with the EPIC (Environmental Policy Integrated Climate) model:
 - Effects of converted grassland parcels to corn/soybeans
 - Effects of abandoned parcels from corn/soybeans to grassland
 - And, then calculated the net effects at the county scale and in total for the 12-state, Midwestern region
- Used two types of tillage (conventional and no-till) and three indicators of soil quality:
 - Erosion
 - Soil nutrient loss: nitrogen (N) and phosphorus (P)
 - Soil Organic Carbon (SOC)
- We published the results in Zhang et al. 2021, Environmental Research Letters
<https://iopscience.iop.org/article/10.1088/1748-9326/abecbe/meta>

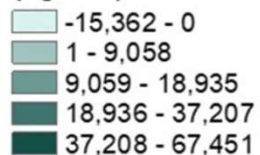


County Scale Impacts

Phosphorus Loss for Expansion - Abandonment

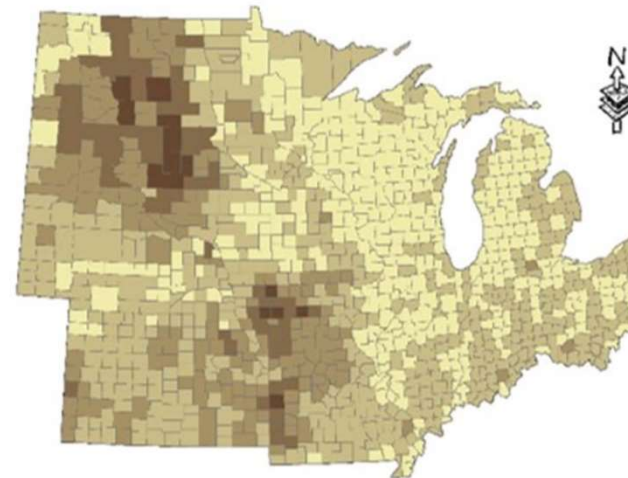


Phosphorus Loss
(KgP Yr⁻¹)

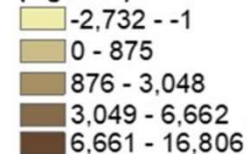


(c)

SOC Loss for Expansion - Abandonment



SOC Loss
(MgC Yr⁻¹)



(d)

- Net effects of conversion of grassland to tilled corn/soybeans and abandonment of tilled corn/soybeans to grassland
- Erosion was highest in southern Iowa and northern Missouri counties; N and P showed a similar spatial pattern



Regional Impacts/Next Step

Table 2. Net environmental impacts of cropland expansion (grassland to tilled corn–soybean) and abandonment (tilled corn–soybean to grassland) for US Midwestern states between 2008 and 2016. Values reflect the simulated impacts summed across all converted and abandoned parcels within the 12 state region.

	Erosion/ sedimentation	Total N loss	Total P loss	Total SOC loss
Total net impact over 12 state area	11.8 (Tg yr ⁻¹)	44.0 (Gg N yr ⁻¹)	4.8 (Gg yr ⁻¹)	673.8 (Gg C yr ⁻¹)
Relative amount compared to US Midwest cropland ^a	7.9%	3.7%	N/A	5.6%
Relative amount compared to CRP benefits for entire US ^b	6.8%	18.6%	10.3%	7.3%

- These are simulated, historic impacts for grassland to corn-soybean conversion, regardless of end-use (e.g., food, fuel, feed) compared to that of cropland and Conservation Reserve Program (CRP) benefits
- Next step is to estimate the fraction of impacts attributable to the Renewable Fuel Standard program